WHAT I CLAIM ARE:

1. A solid-state image pickup device, comprising:

a semiconductor substrate;

a large number of photoelectric converters arranged on one surface of said semiconductor substrate in a plurality of columns and a plurality of rows, each of said columns and said rows including a plurality of photoelectric converters, said photoelectric converters in odd ones of said columns being shifted about one half of a pitch P_1 in a direction of said column relative to said photoelectric converters in even ones of said columns , said photoelectric converters in odd ones of said rows being shifted about one half of a pitch P_2 in a direction of said row relative to said photoelectric converters in even ones of said rows, each said photoelectric converter column including said photoelectric converters of only said odd rows or said even rows;

a vertical charge transfer channel provided for each said photoelectric converter column on the surface of said semiconductor substrate, each said channel being adjacent to an associated photoelectric converter column, each said channel including a plurality of sections of different directions lying in a line, said channel generally extending, while meandering in a zigzag shape, in column direction;

a plurality of transfer electrodes disposed on the surface of said semiconductor substrate to intersect in plan view said charge transfer channels, each said transfer electrode including a plurality of transfer path forming regions which are equal in number to said charge transfer channels, each said transfer path forming region covering one of said sections of said charge transfer channels, said transfer path forming

region and said section disposed thereunder forming one charge transfer stage; each said transfer electrode generally extending in row direction, while two adjacent ones of said transfer electrodes sandwiching one of said photoelectric converter rows therebetween and determining one photoelectric converter region for every second one of said photoelectric converter columns by meeting each other and parting from each other to enclose in plan view every one of said photoelectric converters in said odd or even row; and

a readout gate region disposed contiguous to each said photoelectric converter and to an associated one of said charge transfer channels,

each said charge transfer channel having a first width at location where said channel is contiguous to said readout gate region and a second width at a location where said channel is separated from said readout gate region, said first width being less than said second width.

2. A solid-state image pickup device according to claim 1, wherein said charge transfer channels and said transfer electrodes configure at least two charge transfer stages for each said photoelectric converter.

3. A solid-state image pickup device according to claim 2, wherein said readout gate regions associating to one of said charge transfer channel are contiguous to every second one of said sections of said charge transfer channel.

4. A solid-state image pickup device according to claim 1, further including a plurality of readout gate electrode regions, said readout gate electrode region being disposed on each said readout gate region and covering said readout gate region in plan view, wherein

each said readout gate electrode region is a part of said transfer path forming region covering in plan view one of said sections of said charge transfer channel contiguous to said readout gate region associating to said readout gate electrode region.

5. A solid-state image pickup device according to claim 1, wherein said photoelectric converters are substantially equal to each other in contour, size, and direction in plan view.

6. A solid-state image pickup device according to claim 1, wherein each said photoelectric converter region determined by said two adjacent transfer electrodes sandwiching said one photoelectric converter column therebetween has a contour of substantially a hexagon in plan view.

7. A solid-state image pickup device according to claim 1, further including a light shielding film having an opening provided for each said photoelectric converter, each said opening being disposed over the associated photoelectric converter.

8. A solid-state image pickup device according to claim 7, wherein said openings are substantially equal to each other in contour, size, and direction in plan view.

9. A solid-state image pickup device according to claim 7, wherein each said opening has a contour equal to a rectangle, a pentagon, or a hexagon in plan view.

10. A solid-state image pickup device according to claim 7, further including a microlens provided for each said opening, each said microlens being disposed over the associated opening and covering the opening in plan view.

11. A solid-state image pickup device according to claim 10, further including a color filter provided for each region between said opening and said microlens associating to the opening, said color filter covering the associated opening in plan view.

12. A solid-state image pickup device according to claim 1, further including a output transfer path being composed of a CCD of two-phase driving type with two-layer or three-layer electrode structure, said output transfer path receives, via said charge transfer channels, signal charge stored in each said photoelectric converter through photoelectric conversion conducted by said each photoelectric converter and transfers said signal charge in a predetermined direction.

13. A solid-state image pickup device according to claim 12, further including an adjusting section, said adjusting section including an adjusting charge transfer channel for each said charge transfer channel connected to one end thereof, said adjusting charge transfer channels changing, before said signal charge is transferred to said output transfer path, the transfer direction of said signal charge and adjusting mutual pitch in said photoelectric converter row direction to a constant value.

14. A method of driving the solid-state image pickup device comprising a semiconductor substrate; a large number of photoelectric converters arranged on one surface of said semiconductor substrate in a plurality of columns and a plurality of rows, each of said columns and said rows including a plurality of photoelectric converters, said photoelectric converters in odd ones of said columns being shifted about one half of a pitch P_1 in a direction of said column relative to said photoelectric

converters in even ones of said columns , said photoelectric converters in odd ones of said rows being shifted about one half of a pitch P_2 in a direction of said row relative to said photoelectric converters in even ones of said rows, each said photoelectric converter column including said photoelectric converters of only said odd rows or said even rows; a vertical charge transfer channel provided for each said photoelectric converter column on the surface of said semiconductor substrate, each said channel being adjacent to an associated photoelectric converter column, each said channel including a plurality of sections of different directions lying in a line, said channel generally extending, while meandering in a zigzag shape, in column direction; a plurality of transfer electrodes disposed on the surface of said semiconductor substrate to intersect in plan view said charge transfer channels, each said transfer electrode including a plurality of transfer path forming regions which are equal in number to said charge transfer channels, each said transfer path forming region covering one of said sections of said charge transfer channels, said transfer path forming region and said section disposed thereunder forming one charge transfer stage; each said transfer electrode generally extending in row direction, while two adjacent ones of said transfer electrodes sandwiching one of said photoelectric converter rows therebetween and determining one photoelectric converter region for every second one of said photoelectric converter columns by meeting each other and parting from each other to enclose in plan view every one of said photoelectric converters in said odd or even row; and a readout gate region disposed contiguous to each said photoelectric converter and to an associated

one of said charge transfer channels, each said charge transfer channel having a first width at location where said channel is contiguous to said readout gate region and a second width at a location where said channel is separated from said readout gate region, said first width being less than said second width, comprising the steps of:

reading out, in one vertical blanking period, signal charge stored in each said photoelectric converter of a predetermined photoelectric converter rows, via said associated readout gate region contiguous to said photoelectric converter, to said associated charge transfer channel contiguous to said associated readout gate region; and

converting, from the vertical blanking period to a next vertical blanking period subsequent thereto, each said signal charge read out to said charge transfer channel into an image signal and outputting the image signal.

15. A solid-state image pickup device driving method according to claim 14, wherein said charge transfer channels and said transfer electrodes configure at least two charge transfer stages for each said photoelectric converter.

16. A solid-state image pickup device driving method according to claim 14, wherein said readout gate region associating to said charge transfer channel is contiguous to every second one of said sections of said charge transfer channel.

17. A solid-state image pickup device, comprising;

a semiconductor substrate;

a large number of photoelectric converters arranged on one surface of said semiconductor substrate in a plurality of columns and a

plurality of rows, each of said columns and said rows including a plurality of photoelectric converters, said photoelectric converters in odd ones of said columns being shifted about one half of a pitch P_1 in a direction of said column relative to said photoelectric converters in even ones of said columns , said photoelectric converters in odd ones of said rows being shifted about one half of a pitch P_2 in a direction of said row relative to said photoelectric converters in even ones of said rows, each said photoelectric converter column including said photoelectric converters of only said odd rows or said even rows;

a vertical charge transfer channel provided for each said photoelectric converter column on the surface of said semiconductor substrate, each said channel being adjacent to an associated photoelectric converter column, each said channel including a plurality of sections of different directions lying in a line, said channel generally extending, while meandering in a zigzag shape, in column direction;

a plurality of transfer electrodes disposed on the surface of said semiconductor substrate to intersect in plan view said charge transfer channels, each said transfer electrode including a plurality of transfer path forming regions which are equal in number to said charge transfer channels, each said transfer path forming region covering one of said sections of said charge transfer channels, said transfer path forming region and said section disposed thereunder forming one charge transfer stage; each said transfer electrode generally extending in row direction, while two adjacent ones of said transfer electrodes sandwiching one of said photoelectric converter rows therebetween and determining one photoelectric converter region for every second one of

said photoelectric converter columns by meeting each other and parting from each other to enclose in plan view every one of said photoelectric converters in said odd or even row; and

a readout gate region disposed contiguous to each said photoelectric converter and to an associated one of said charge transfer channels,

said readout gate regions being equal to each other in relative positional relationship with said associated photoelectric converter, each said readout gate region associating to one of said photoelectric converter rows being covered in plan view with mutually different ones of said transfer path forming regions of said one transfer electrode associating to said photoelectric converter row.

18. A solid-state image pickup device according to claim 17, wherein said charge transfer channels and said transfer electrodes configure at least two charge transfer stages for each said photoelectric converter.

19. A solid-state image pickup device according to claim 17, said transfer electrodes include a plurality of first transfer electrodes and a plurality of second transfer electrodes, said first and second transfer electrodes being alternately provided on the surface of said semiconductor substrate to intersect in plan view said charge transfer channels, each said first and second transfer electrode including a plurality of transfer path forming regions which are equal in number to said charge transfer channels, each said transfer path forming region covering one of said sections of said charge transfer channels, said transfer path forming region and said section disposed thereunder forming one charge transfer stage; each said first and second transfer

electrode generally extending in row direction, while one of said first transfer electrodes and one of said second transfer electrodes adjacent to said one first transfer electrode sandwiching one of said photoelectric converter rows therebetween and determining one photoelectric converter region for every second one of said photoelectric converter columns by meeting each other and parting from each other to enclose in plan view every one of said photoelectric converters in said odd or even row.

20. A solid-state image pickup device according to claim 19, wherein:

each said readout gate region contiguous to odd one of said charge transfer channels is contiguous to said section covered with said transfer path forming region of either one of said first and second transfer electrodes, and

each said readout gate region contiguous to even one of said charge transfer channels is contiguous to said section covered with said transfer path forming region of other one of said first and second transfer electrodes.

21. A solid-state image pickup device according to claim 17, further including a plurality of readout gate electrode regions, said readout gate electrode region being disposed on each said readout gate region and covering said readout gate region in plan view, wherein

each said readout gate electrode region is a part of said transfer path forming region covering in plan view one of said section of said charge transfer channel contiguous to said readout gate region associating to said readout gate electrode region.

22. A solid-state image pickup device according to claim 17, wherein

said photoelectric converters are substantially equal to each other in contour, size, and direction in plan view.

23. A solid-state image pickup device according to claim 17, wherein each said photoelectric converter region determined by said two adjacent transfer electrodes sandwiching said one photoelectric converter column therebetween has a contour of substantially a hexagon in plan view.

24. A solid-state image pickup device according to claim 17, further including a light shielding film having an opening provided for each said photoelectric converter, each said opening being disposed over the associated photoelectric converter.

25. A solid-state image pickup device according to claim 24, wherein said openings are substantially equal to each other in contour, size, and direction in plan view.

26. A solid-state image pickup device according to claim 24, wherein each said opening has a contour equal to a rectangle, a pentagon, or a hexagon in plan view.

27. A solid-state image pickup device according to claim 24, further including a microlens provided for each said opening, each said microlens being disposed over the associated opening and covering the opening in plan view.

28. A solid-state image pickup device according to claim 27, further including a color filter provided for each region between said opening and said microlens associating to the opening, said color filter covering the associated opening in plan view.

29. A solid-state image pickup device according to claim 17, further

including a driver circuit for applying filed shift pulses respectively to said transfer electrodes of which said transfer path forming regions cover said readout gate regions in plan view.

30. A solid-state image pickup device according to claim 19, further including a driver circuit for applying filed shift pulses respectively to said first and second transfer electrodes.

31. A solid-state image pickup device according to claim 17, further including a output transfer path being composed of a CCD of two-phase driving type with two-layer or three-layer electrode structure, said output transfer path receives, via said charge transfer channels, signal charge stored in each said photoelectric converter through photoelectric conversion conducted by said each photoelectric converter and transfers said signal charge in a predetermined direction.

32. A solid-state image pickup device according to claim 31, further including an adjusting section, said adjusting section including an adjusting charge transfer channel for each said charge transfer channel connected to one end thereof, said adjusting charge transfer channels changing, before said signal charge is transferred to said output transfer path, the transfer direction of said signal charge and adjusting mutual pitch in said photoelectric converter row direction to a constant value.

33. A method of driving the solid-state image pickup device comprising a semiconductor substrate; a large number of photoelectric converters arranged on one surface of said semiconductor substrate in a plurality of columns and a plurality of rows, each of said columns and said rows including a plurality of photoelectric converters, said photoelectric

converters in odd ones of said columns being shifted about one half of a pitch P_1 in a direction of said column relative to said photoelectric converters in even ones of said columns , said photoelectric converters in odd ones of said rows being shifted about one half of a pitch P_2 in a direction of said row relative to said photoelectric converters in even ones of said rows, each said photoelectric converter column including said photoelectric converters of only said odd rows or said even rows; a vertical charge transfer channel provided for each said photoelectric converter column on the surface of said semiconductor substrate, each said channel being adjacent to an associated photoelectric converter column, each said channel including a plurality of sections of different directions lying in a line, said channel generally extending, while meandering in a zigzag shape, in column direction; a plurality of transfer electrodes disposed on the surface of said semiconductor substrate to intersect in plan view said charge transfer channels, each said transfer electrode including a plurality of transfer path forming regions which are equal in number to said charge transfer channels, each said transfer path forming region covering one of said sections of said charge transfer channels, said transfer path forming region and said section disposed thereunder forming one charge transfer stage; each said transfer electrode generally extending in row direction, while two adjacent ones of said transfer electrodes sandwiching one of said photoelectric converter rows therebetween and determining one photoelectric converter region for every second one of said photoelectric converter columns by meeting each other and parting from each other to enclose in plan view every one of said photoelectric

converters in said odd or even row; and a readout gate region disposed contiguous to each said photoelectric converter and to an associated one of said charge transfer channels, said readout gate regions being equal to each other in relative positional relationship with said associated photoelectric converter, each said readout gate region associating to one of said photoelectric converter rows being covered in plan view with mutually different ones of said transfer path forming regions of said one transfer electrode associating to said photoelectric converter row, comprising the steps of:

reading out, in one vertical blanking period, signal charge stored in each said photoelectric converter of at least part of said photoelectric converter rows, via said associated readout gate region contiguous to said photoelectric converter, to said associated charge transfer channel contiguous to said associated readout gate region; and

converting, from the vertical blanking period to a next vertical blanking period subsequent thereto, each said signal charge read out to said charge transfer channel into an image signal and outputting the image signal.

34. A solid-state image pickup device driving method according to claim 33, wherein said charge transfer channels and said transfer electrodes configure at least two charge transfer stages for each said photoelectric converter.

35. A solid-state image pickup device driving method according to claim 33, wherein said transfer electrodes include a plurality of first transfer electrodes and a plurality of second transfer electrodes, said first and second transfer electrodes being alternately provided on the

surface of said semiconductor substrate to intersect in plan view said charge transfer channels, each said first and second transfer electrode including a plurality of transfer path forming regions which are equal in number to said charge transfer channels, each said transfer path forming region covering one of said sections of said charge transfer channels, said transfer path forming region and said section disposed thereunder forming one charge transfer stage; each said first and second transfer electrode generally extending in row direction, while one of said first transfer electrodes and one of said second transfer electrodes adjacent to said one first transfer electrode sandwiching one of said photoelectric converter rows therebetween and determining one photoelectric converter region for every second one of said photoelectric converter columns by meeting each other and parting from each other to enclose in plan view every one of said photoelectric converters in said odd or even row.

36. A solid-state image pickup device driving method according to claim 35, wherein each said readout gate region contiguous to odd one of said charge transfer channels is contiguous to said section covered with said transfer path forming region of either one of said first and second transfer electrodes, and

each said readout gate region contiguous to even one of said charge transfer channels is contiguous to said section covered with said transfer path forming region of other one of said first and second transfer electrodes.